

rapidly as they were introduced by the sewage. But both the grit and the cellulose matters could be separated by sedimentation; and the cellulose matters might, according to modern research, be slowly resolved by the action of suitable bacteria, if such could be established. Accordingly, it was arranged that the crude sewage should undergo a preliminary settlement in a deep tank, where the sediment should remain undisturbed in the hope that bacterial resolution of the organic matters in the deposit might occur.

This settling or so-called "septic" tank was found after a time to effect the resolution of the cellulose matters most satisfactorily, the necessary bacteria being evidently contained in the sewage. The amount of sediment which should have been found at the bottom of the tank was estimated by carefully gauging the volume of sewage which passed through the tank in the course of six months and determining the amount of suspended matter which the sewage contained. When the actual amount of sediment present in the tank at the end of this period was measured, it was found to correspond to about 50 per cent. of the total quantity introduced, and the sediment which remained consisted largely of the grit which had not been previously separated. It was therefore possible to dispose of the troublesome cellulose matter by long-maintained bacterial action in the settling tank, and to prevent it from clogging the coke-beds.

The final experimental stage consisted in passing the screened crude sewage through a settling tank, which was of such capacity that the sewage required five hours to pass through it and was so arranged that the sediment was undisturbed by the flow. The effluent from this tank was received successively in a series of coke-beds, in which it was treated in the way already described. After two hours' contact with the coke, it issued as an inoffensive and non-putrescible effluent which readily maintained the life of fish. The sediment in the settling tank was left entirely undisturbed. As soon as it had become permeated with its suitable bacteria, more than 50 per cent. of it was resolved into gaseous and soluble substances, and it was certain that a preliminary sedimentation of the grit must have further increased this percentage.

The sewage capacity of the coke-bed, on the other hand, was carefully gauged at intervals. It was found that the capacity diminished during the formation of the bacterial growth upon the coke surfaces, and that when this was complete the capacity of the bed was about 30 per cent. of the whole space which had been filled with coke and with sewage. No permanent alteration in capacity occurred during many months, although the capacity temporarily rose or fell by a few units per cent. from the average.

It appeared, therefore, that the above method of treatment was applicable to London sewage and that it might now be applied on the large scale. The experimental work was accordingly suspended, and the conclusions arrived at were stated and recommendations were framed in the following words:—

"Conclusions arrived at by the Experimental Treatment."

"(1) That by suitable continuous undisturbed sedimentation the raw sewage is deprived of matter which would choke the coke-beds, and the sludge which settles on is reduced in amount by bacterial action to a very considerable extent. This reduction might undoubtedly be increased by the preliminary removal of road detritus.

"(2) That the coke-beds, after they have developed their full purifying power by use, have an average sewage capacity of about 30 per cent. of the whole space which has been filled with coke.

"(3) That the sewage capacity of the coke-bed, when the bed is fed with settled sewage, fluctuates slightly, but undergoes no permanent reduction. The bed does not choke, and its purifying power undergoes steady improvement for some time.

"(4) That coke of suitable quality does not disintegrate during use.

"(5) That the 'bacterial effluent' of settled sewage from the coke-beds does not undergo offensive putrefaction at all even in summer heat, and can never become offensive. That this effluent satisfactorily supports the respiration of fish.

"(6) That the use of chemicals is quite unnecessary under any circumstances when the above method of treatment is adopted.

"Recommendations founded on the above Conclusions."

"It would appear desirable, therefore, without delay, to commence the treatment of the London sewage by the above bacterial method. The construction of the necessary works will

take time and will involve expenditure, but unless it is taken in hand, all considerations tend to show that owing to the increased abstraction of water by the water companies, both at their existing intakes and at the newly constructed reservoirs for storm water at Staines, a large portion of the lower river will continuously deteriorate. This deterioration would arise from the increase in the amount of the discharge of sewage effluent and the decrease in the upper river flush. Possible trouble arising from these causes will be absolutely prevented by adopting, under proper conditions and on a large scale, the treatment which has been strikingly successful on the experimental scale. It must be remembered that the condition of the river cannot be improved by any suddenly adopted action.

"If the treatment is introduced without delay and is gradually extended it may reasonably be expected that the increasing deterioration in the lower river water will first be checked and will ultimately be prevented; while the gradual development of the treatment will cause the expenditure to be spread over a period of years, and will prevent it from being unduly burdensome.

"It must be remembered that the present settling channels would serve, as at present, for settling purposes, but by the altered method of working them they would also act as sludge destroyers. They should, however, undoubtedly be preceded by grit chambers.

"It must be further borne in mind that the expense involved in the purchase and application of chemicals would be dispensed with."

Other conclusions, which were incidentally arrived at during the above experimental work, may be mentioned. The material used for filling the bacteria bed seems to exert no considerable influence on the purification obtained; coke proved to be the most efficient, ragstone containing calcium carbonate was less efficient, but the difference in efficiency was not of serious amount.

The depth of the coke-bed did not materially affect its efficiency between the limits tried, which ranged from four feet to twelve feet. In the interspaces of the coke, even in the deepest bed, a satisfactory proportion of oxygen was present in the air; the bed was able to aerate itself without mechanical aid.

The amount of sewage dealt with satisfactorily by the system of intermittent filling of the coke-bed described above was greater than that which could be similarly purified by a continuous supply furnished by sprinkling or by other methods of distribution.

The report concludes with detailed information concerning the bacterial treatment of their sewage by the authorities in forty-eight of the principal centres of population in this country. This information has been supplied by the responsible officers from the centres concerned and has been brought up to date of April 30, 1902.

A consideration of this information in conjunction with that supplied concerning the London experimental work will probably be felt to justify the opinion "that the process (of bacterial treatment of sewage) has been uniformly successful when the construction and use of the necessary plant has been reasonably and properly carried out," and that the metropolis may now safely adopt this "natural" method of sewage disposal.

FRANK CLOWES.

SILICA GLASS.

A FEW weeks ago we described some of the excellent results obtained by Messrs. Heraeus, of Hanau, in their attempts to produce apparatus of "silica glass," and Prof. Dewar has added point to our remarks by exhibiting at the Royal Institution a "liquid air holder" made of silica, which had been made to order and sent by return of post, almost, from Hanau to London a few days before. Similar apparatus could have been made in England, it is true, but it could not have been produced by any means so quickly as at Hanau. Now we receive from America an account of an animated discussion on the subject of "silica glass" which lately took place at a meeting of the American Electrochemical Society at Niagara Falls on the occasion of the reading of a paper, by Mr. R. S. Hutton, of Manchester, on his method of casting silica tubes in the electric furnace, which shows that our American cousins

are as fully aware of the importance of this subject as our German competitors.

Truly, as Prof. Dewar said the other evening, there will soon be another "lost industry" if our practical men do not wake up. Silica glass making as an industry no doubt is still in earliest infancy, but though so young, it already shows signs of growth. But, alas! whilst two years ago England was first in this matter and the rest of the world, almost, nowhere, already England is only second, and is standing still, whilst Germany is first, and is going forward.

Everyone who has worked with silica, and knows its properties and how comparatively easy it is to work with, foresees that soon silica glass will replace ordinary glass in many of its most important applications, and yet though the foundations of the coming new industry were laid in this country, none of our manufacturers has been willing to take the small risks and trouble involved in an attempt to carry out in the workshop, and with electric furnaces, the new processes, or modifications of them, which have been worked out in the laboratories and placed at their disposal by the experimenters. It is true that owing to the initiative of one firm—Messrs. Baird and Tatlock—silica glass made by Mr. Shenstone's oxyhydrogen flame—or laboratory—process has for some time been available in this country. But can it be supposed that this essentially laboratory process is the last word of science, or of workshop practice, on this subject, or is likely to hold the field permanently, except for work on the small scale.

It is still fresh in our memories how the makers of optical glass waited until German manufacturers, aided by German men of science, had revolutionised and captured their industry. Unless something is done at once by the combined action of our men of science and manufacturers, history will repeat itself in the case of this new material.

SIR WILLIAM HOOKER'S SCIENTIFIC WORK.

SIR JOSEPH HOOKER contributes to the January number of the *Annals of Botany* a sketch of the life and labours of his father, Sir William Jackson Hooker, accompanied by a portrait. Sir William Hooker was born at Norwich on July 6, 1785, and in due course attended the Norwich Grammar School, but little is known of the progress he made there, though his son tells us that at home he devoted himself to entomology, drawing, and reading books of travel and natural history. Early in life he became interested in ornithology. That his entomological pursuits were, when still in his teens, appreciated by the veteran Kirby is evidenced by the latter having, in 1805, dedicated to him and his brother a species of Apion. The first evidence of his having taken up botany is the fact that he was the discoverer in Britain, in 1805, of *Buxbaumia aphylla*. His first published paper, entitled "Musci Nepalenses," was read before the Linnean Society in June, 1807. In 1809, following the suggestion of Sir Joseph Banks, Hooker visited Iceland, and in 1813 his "Journal of a Tour in Iceland" was published, though it had been privately circulated in 1811. In 1816 he produced the first part of a work entitled "Plantæ Cryptogamicæ, quæ in plaga orbis novi Aequinoctialis colligerunt Alex^r von Humboldt et Aimat Bonpland." The first volume of "Musci Exotici" appeared in 1818 and the second in 1820. Hooker was in 1820 appointed professor of botany at Glasgow University, and remained there until 1841, when he was appointed director of the Botanic Gardens at Kew. At Glasgow he met with the greatest success, and his herbarium and library before he had been there ten years were reckoned as amongst the richest private ones in Europe, and botanists of every nationality repeatedly visited them. The scientific works published during the Glasgow period were very numerous, and Sir J. D. Hooker gives a list of them in an appendix. The directorship at Kew Gardens was held by Sir William for twenty-four years, until his death on August 12, 1865. From 1855 he was assisted by his son, Sir Joseph Hooker, who was in that year appointed assistant director. Such are a few of the many incidents in an exceedingly busy life. Sir Joseph Hooker has conferred a favour upon men of science by bringing together, in convenient compass, the leading facts of an illustrious career.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. E. J. Routh, F.R.S., has been appointed a governor of Dulwich College, and Dr. E. W. Hobson, F.R.S., a governor of Derby School.

The special board for moral science propose that, in view of the progress of the department of experimental psychology under Dr. Rivers, an annual grant of 50*l.* shall be made towards the expenses of the department, and a special grant of 50*l.* for apparatus.

Mr. W. L. Mollison, Clare, has been appointed an elector to the Plumian professorship of astronomy; Dr. J. Larmor, F.R.S., has been appointed an elector to the same professorship, and to the Isaac Newton studentship; Prof. H. B. Dixon, F.R.S., of Manchester, an elector to the Jacksonian professorship of natural philosophy; Prof. H. A. Miers, F.R.S., of Oxford, an elector to the chair of mineralogy; and Dr. R. T. Glazebrook, F.R.S., an elector to the Cavendish professorship of experimental physics.

It is announced in the *Globe* of February 21 that a commission has been appointed in Pretoria to inquire what steps can be taken for the creation of an institution to form part of a teaching university to provide the highest training in the arts and sciences connected with mining and other industries.

Two Pfeiffer scholarships in science, each of the annual value of 48*l.*, and tenable for three years at Bedford College for Women, will be offered for competition in June, 1903. Two Deccan scholarships, offered by Mrs. Thomson, of Poona, Bombay, of the value of 50*l.* each per annum for three years, will also be awarded.

The principal of the Northampton Institute, London, Dr. R. Mullineux Walmsley, is being sent on a three months' tour to the United States and Canada for the purpose of investigating the present position of technical education in those countries and its bearings upon industrial production in the subjects covered by the technological work of the Institute, but more especially in the engineering industries.

A STATUTE enacting that persons who have passed the Abiturienten examination at a gymnasium in Germany, Austro-Hungary or Switzerland shall be exempt from Responsions and from the examination in an additional subject at Responsions at the University of Oxford was presented to a congregation of the University on February 17. The preamble of the statute was approved by congregation on February 3, and as no amendment had been proposed, the statute was submitted and approved.

SIR WILLIAM ABNEY, K.C.B., F.R.S., has accepted the post of adviser to the Board of Education in matters connected with science, upon his retirement from the post of principal assistant secretary to the South Kensington branch of the Board on April 1 next. It has been decided from that date to organise a division of the staff of the Board for matters connected with technology and higher education in science and art. The President has appointed Mr. Grant Ogilvie (at present the director of the Edinburgh Museum of Science and Art under the Scottish Education Department) to be a principal assistant secretary of the Board in charge of this division as from April 1 next. The Hon. W. N. Bruce, assistant secretary of the Board, is to be promoted on that date to be principal assistant secretary in charge of another division of the Board, which will be organised to deal with secondary schools.

THE council of the Association of Technical Institutions, after consultation with the London Members of Parliament, has adopted resolutions urging that it is of importance that an Education Bill for London should be passed into law during the present session; that there should be but one education authority for London for all grades of education, and such authority should be the London County Council, acting through an education committee constituted by statute; that a majority of this committee should be appointed by and out of the Council, and be so chosen that there shall be at least one County Council member from the City of London and from each metropolitan borough; and the committee should also include one person nominated by